

# NTP6N50

Preferred Devices

## Product Preview

# Power MOSFET 6 Amps, 500 Volts N-Channel TO-220

Designed for high voltage, high speed switching applications in power supplies, converters, power motor controls and bridge circuits.

### Features

- Higher Current Rating
- Lower  $R_{DS(on)}$
- Lower Capacitances
- Lower Total Gate Charge
- Tighter  $V_{SD}$  Specifications
- Avalanche Energy Specified

### Typical Applications

- Switch Mode Power Supplies
- PWM Motor Controls
- Converters
- Bridge Circuits

### MAXIMUM RATINGS ( $T_C = 25^\circ\text{C}$ unless otherwise noted)

Rating	Symbol	Value	Unit
Drain-Source Voltage	$V_{DSS}$	500	Vdc
Drain-Gate Voltage ( $R_{GS} = 1.0\text{ M}\Omega$ )	$V_{DGR}$	500	Vdc
Gate-Source Voltage	$V_{GS}$	$\pm 20$	Vdc
- Continuous	$V_{GS}$	$\pm 40$	
- Non-Repetitive ( $t_p \leq 10\text{ ms}$ )			
Drain-Continuous @ $T_A 25^\circ\text{C}$	$I_D$	6.0	Adc
- Continuous @ $T_A 100^\circ\text{C}$	$I_D$	5.0	
- Single Pulse ( $t_p \leq 10\ \mu\text{s}$ )	$I_{DM}$	18	Apk
Total Power Dissipation @ $T_A 25^\circ\text{C}$	$P_D$	104	Watts
Derate above $25^\circ\text{C}$		0.83	W/ $^\circ\text{C}$
Total Power Dissipation @ $T_A 25^\circ\text{C}$ (Note 1.)		1.75	Watts
Operating and Storage Temperature Range	$T_J, T_{stg}$	-55 to +150	$^\circ\text{C}$
Single Drain-to-Source Avalanche Energy - Starting $T_J = 25^\circ\text{C}$ ( $V_{DD} = 100\text{ V}$ , $V_{GS} = 10\text{ Vdc}$ , $I_L(pk) = 6\text{ A}$ , $L = 10\text{ mH}$ , $V_{DS} = 500\text{ Vdc}$ , $R_G = 25\ \Omega$ )	$E_{AS}$	180	mJ
Thermal Resistance	$R_{\theta JC}$	1.2	$^\circ\text{C/W}$
- Junction-to-Case	$R_{\theta JA}$	62.5	
- Junction-to-Ambient			
Maximum Lead Temperature for Soldering Purposes, 1/8" from case for 10 seconds	$T_L$	260	$^\circ\text{C}$

1. Repetitive rating; pulse width limited by maximum junction temperature.

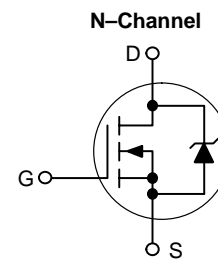
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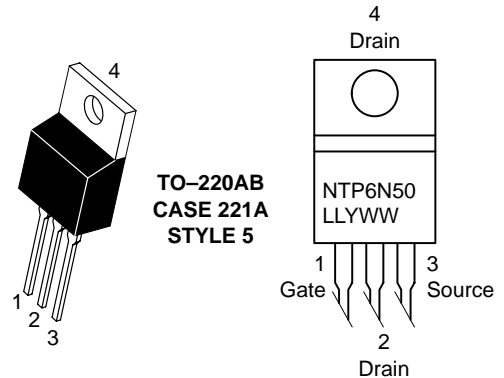
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**6 AMPERES**  
**500 VOLTS**  
 **$R_{DS(on)} = 1700\text{ m}\Omega$**



### MARKING DIAGRAM & PIN ASSIGNMENT



NTP6N50 = Device Code  
LL = Location Code  
Y = Year  
WW = Work Week

### ORDERING INFORMATION

Device	Package	Shipping
NTP6N50	TO-220AB	50 Units/Rail

Preferred devices are recommended choices for future use and best overall value.

# NTP6N50

## ELECTRICAL CHARACTERISTICS (T<sub>C</sub> = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
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### OFF CHARACTERISTICS

Drain-to-Source Breakdown Voltage (Note 2.) (V <sub>GS</sub> = 0 Vdc, I <sub>D</sub> = 250 μAdc) Temperature Coefficient (Positive)	V <sub>(BR)DSS</sub>	500 –	– 590	– –	Vdc mV/°C
Zero Gate Voltage Drain Current (V <sub>DS</sub> = 500 Vdc, V <sub>GS</sub> = 0 Vdc) (V <sub>DS</sub> = 500 Vdc, V <sub>GS</sub> = 0 Vdc, T <sub>J</sub> = 125°C)	I <sub>DSS</sub>	– –	– –	10 100	μAdc
Gate-Body Leakage Current (V <sub>GS</sub> = ±20 Vdc, V <sub>DS</sub> = 0 Vdc)	I <sub>GSS</sub>	–	–	±100	nAdc

### ON CHARACTERISTICS (Note 2.)

Gate Threshold Voltage (V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μAdc) Temperature Coefficient (Negative)	V <sub>GS(th)</sub>	2.0 –	3.1 6.4	4.0 –	Vdc mV/°C
Static Drain-to-Source On-Resistance (V <sub>GS</sub> = 10 Vdc, I <sub>D</sub> = 3 Adc)	R <sub>DS(on)</sub>	–	1300	1700	mΩ
Static Drain-to-Source On-Resistance (V <sub>GS</sub> = 10 Vdc, I <sub>D</sub> = 6 Adc) (V <sub>GS</sub> = 10 Vdc, I <sub>D</sub> = 3 Adc, T <sub>J</sub> = 125°C)	V <sub>DS(on)</sub>	– –	– –	12.2 11.0	V
Forward Transconductance (V <sub>DS</sub> = 15 Vdc, I <sub>D</sub> = 3 Adc)	g <sub>FS</sub>	–	6.7	–	mhos

### DYNAMIC CHARACTERISTICS

Input Capacitance	(V <sub>DS</sub> = 25 Vdc, V <sub>GS</sub> = 0 Vdc, f = 1.0 MHz)	C <sub>iss</sub>	–	520	730	pF
Output Capacitance		C <sub>oss</sub>	–	170	240	
Transfer Capacitance		C <sub>rss</sub>	–	5.0	20	

### SWITCHING CHARACTERISTICS (Note 3.)

Turn-On Delay Time	(V <sub>DD</sub> = 250 Vdc, I <sub>D</sub> = 6 Adc, V <sub>GS</sub> = 10 Vdc, R <sub>G</sub> = 9.1 Ω)	t <sub>d(on)</sub>	–	9.0	20	ns
Rise Time		t <sub>r</sub>	–	12	20	
Turn-Off Delay Time		t <sub>d(off)</sub>	–	17	40	
Fall Time		t <sub>f</sub>	–	12	30	
Gate Charge	(V <sub>DS</sub> = 400 Vdc, I <sub>D</sub> = 6 Adc, V <sub>GS</sub> = 10 Vdc)	Q <sub>T</sub>	–	10	20	nC
		Q <sub>1</sub>	–	3.0	–	
		Q <sub>2</sub>	–	6.0	–	

### SOURCE-DRAIN DIODE CHARACTERISTICS

Forward On-Voltage (Note 2.)	(I <sub>S</sub> = 6 Adc, V <sub>GS</sub> = 0 Vdc) (I <sub>S</sub> = 6 Adc, V <sub>GS</sub> = 0 Vdc, T <sub>J</sub> = 125°C)	V <sub>SD</sub>	– –	0.9 0.8	1.0 –	Vdc
Reverse Recovery Time	(I <sub>S</sub> = 6 Adc, V <sub>GS</sub> = 0 Vdc, di <sub>S</sub> /dt = 100 A/μs)	t <sub>rr</sub>	–	251	–	ns
		t <sub>a</sub>	–	168	–	
		t <sub>b</sub>	–	83	–	
Reverse Recovery Stored Charge		Q <sub>RR</sub>	–	2.3	–	μC

2. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.

3. Switching characteristics are independent of operating junction temperature.

# NTP6N50

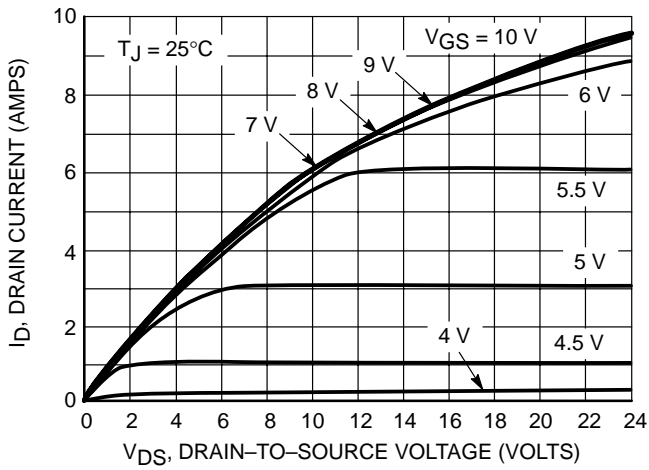


Figure 1. On-Region Characteristics

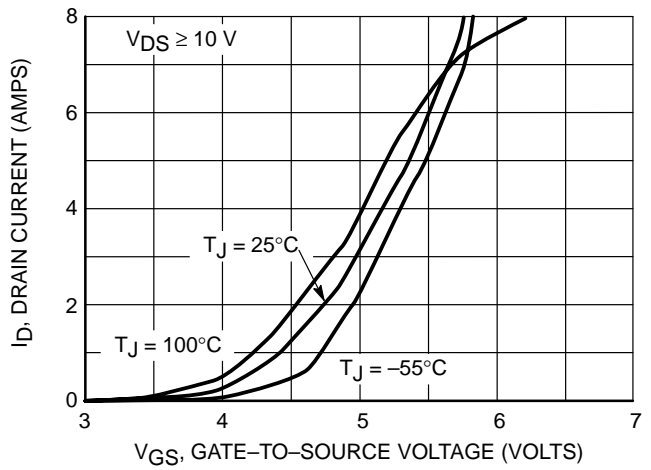


Figure 2. Transfer Characteristics

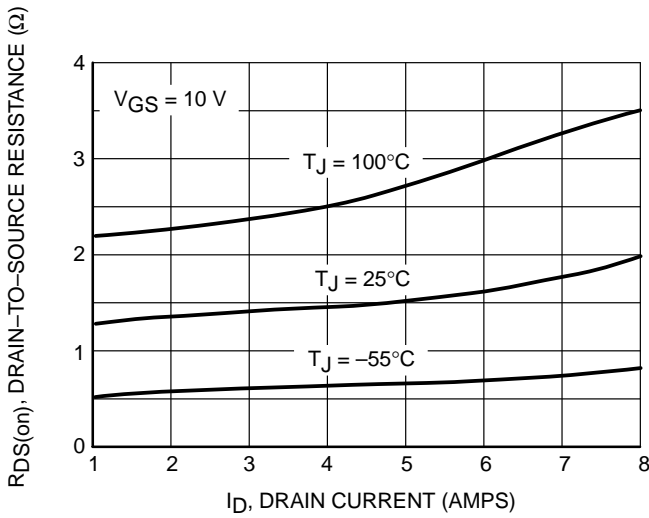


Figure 3. On-Resistance versus Drain Current and Temperature

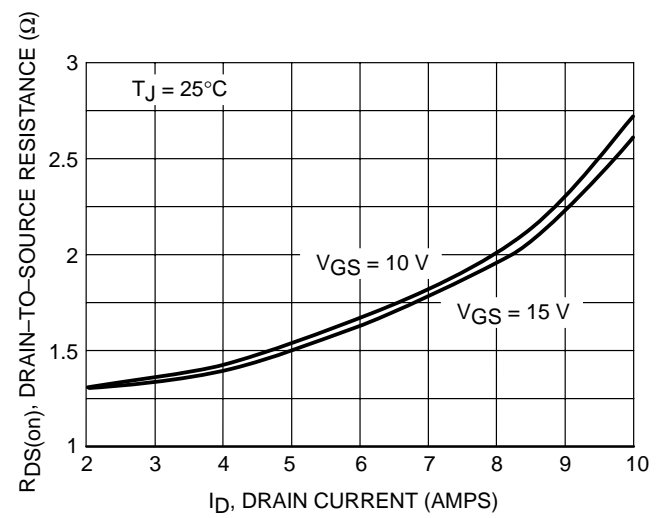


Figure 4. On-Resistance versus Drain Current and Gate Voltage

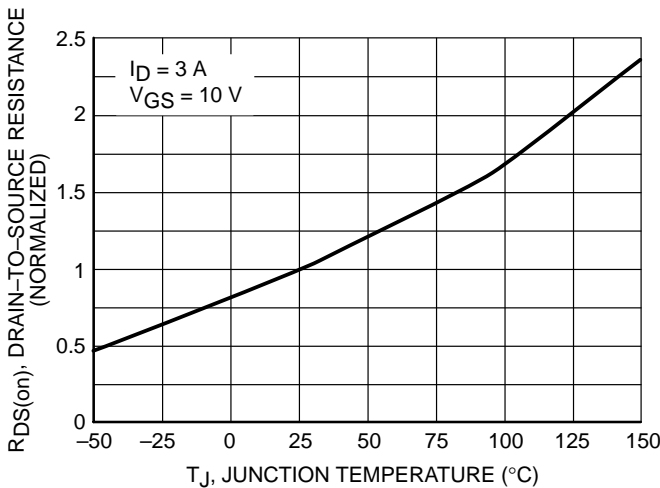


Figure 5. On-Resistance Variation with Temperature

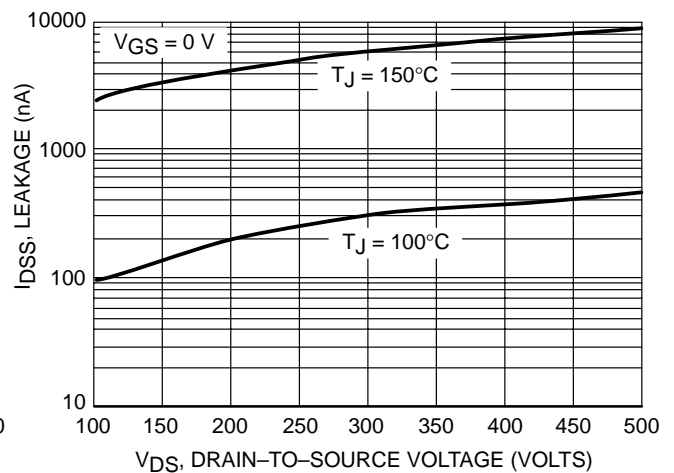
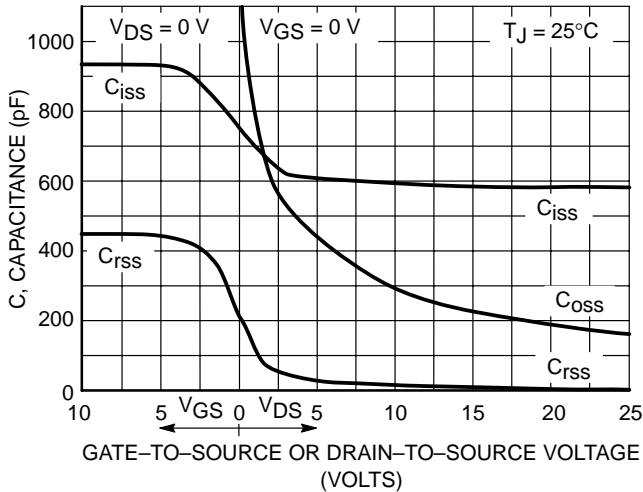
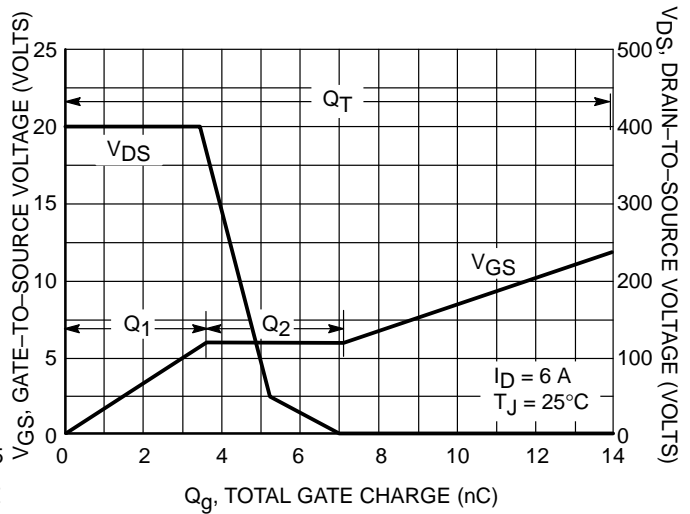


Figure 6. Drain-to-Source Leakage Current versus Voltage

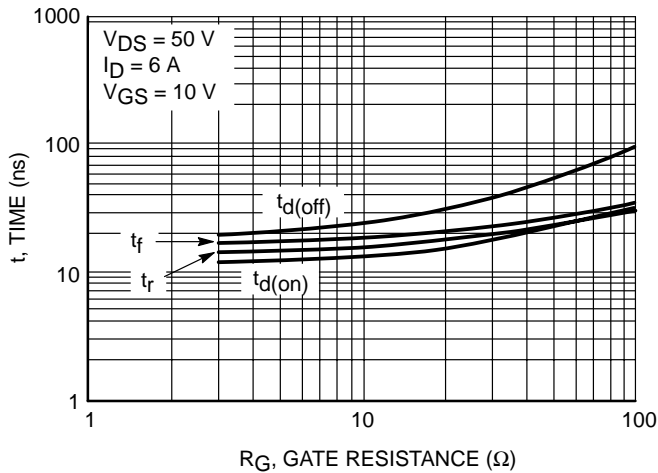
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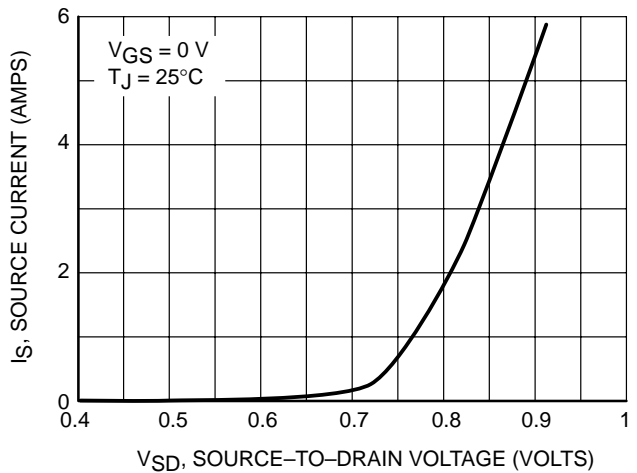
**Figure 7. Capacitance Variation**



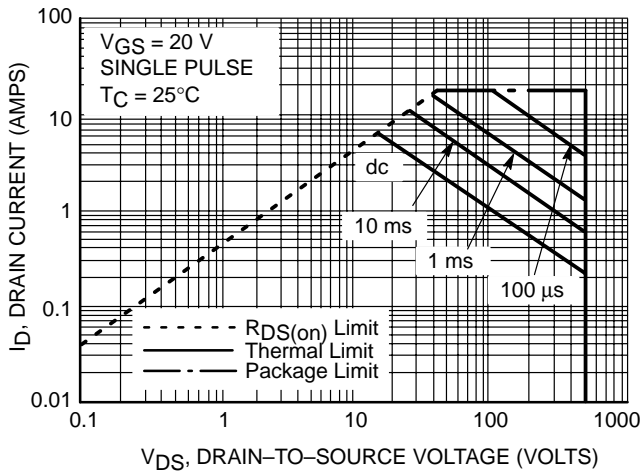
**Figure 8. Gate-to-Source and Drain-to-Source Voltage versus Total Charge**



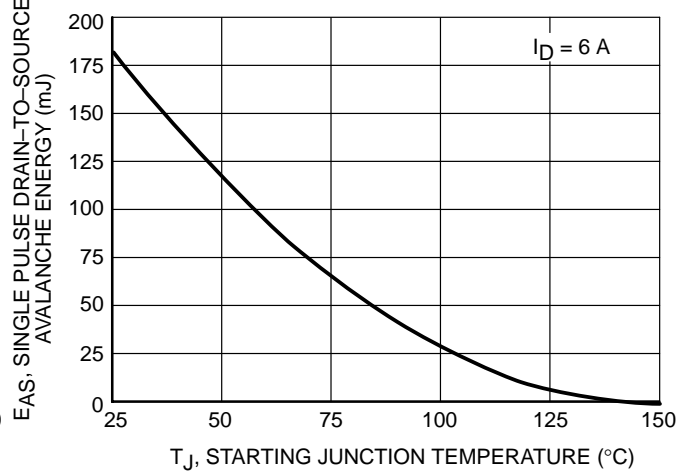
**Figure 9. Resistive Switching Time Variation versus Gate Resistance**



**Figure 10. Diode Forward Voltage versus Current**



**Figure 11. Maximum Rated Forward Biased Safe Operating Area**



**Figure 12. Maximum Avalanche Energy versus Starting Junction Temperature**

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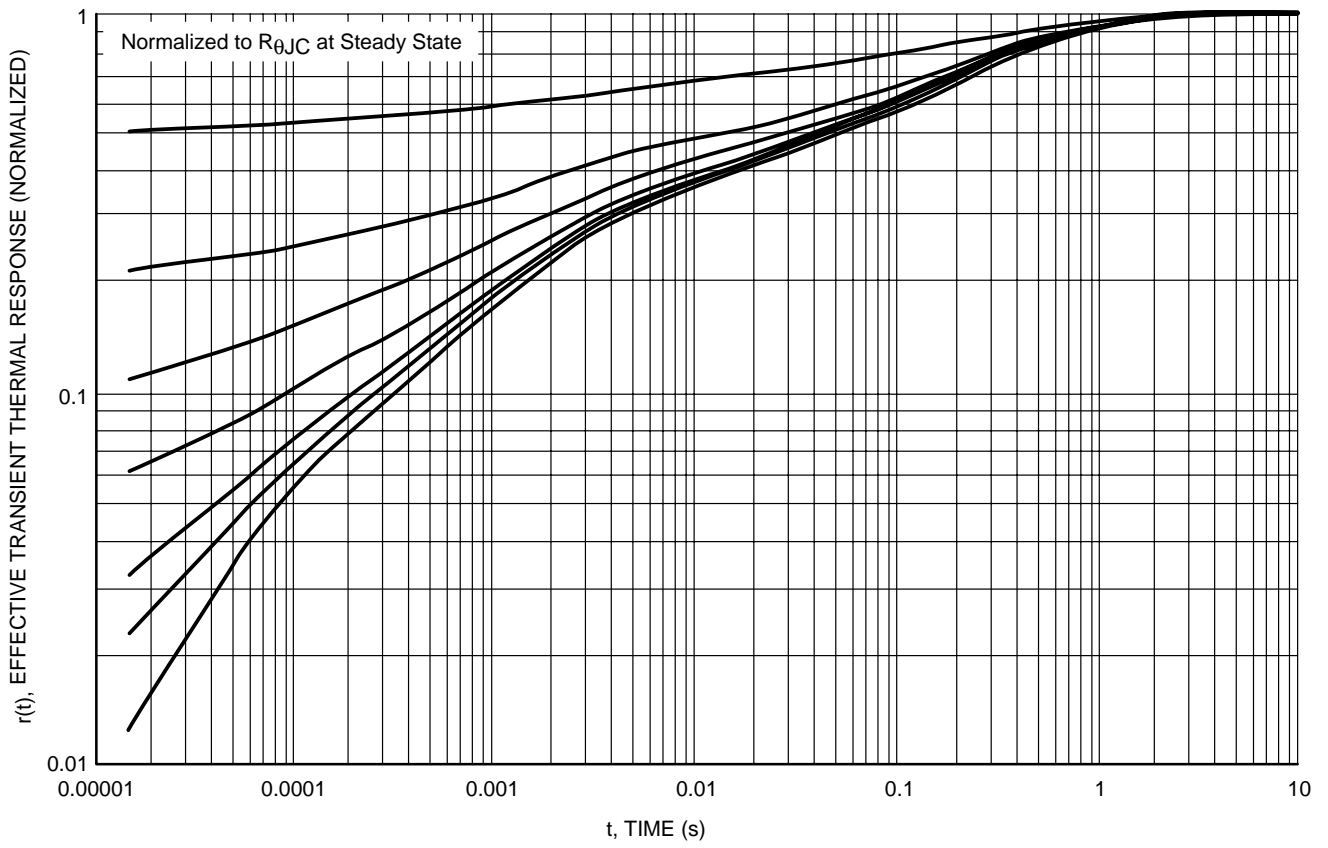
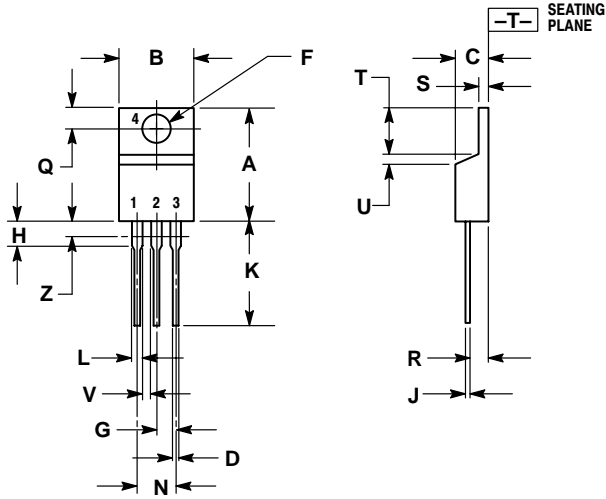


Figure 13. Thermal Response

# NTP6N50

## PACKAGE DIMENSIONS

TO-220 THREE-LEAD  
TO-220AB  
CASE 221A-09  
ISSUE AA



NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.570	0.620	14.48	15.75
B	0.380	0.405	9.66	10.28
C	0.160	0.190	4.07	4.82
D	0.025	0.035	0.64	0.88
F	0.142	0.147	3.61	3.73
G	0.095	0.105	2.42	2.66
H	0.110	0.155	2.80	3.93
J	0.018	0.025	0.46	0.64
K	0.500	0.562	12.70	14.27
L	0.045	0.060	1.15	1.52
N	0.190	0.210	4.83	5.33
Q	0.100	0.120	2.54	3.04
R	0.080	0.110	2.04	2.79
S	0.045	0.055	1.15	1.39
T	0.235	0.255	5.97	6.47
U	0.000	0.050	0.00	1.27
V	0.045	---	1.15	---
Z	---	0.080	---	2.04

STYLE 5:

- PIN 1. GATE
- DRAIN

**Notes**

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